

# PATENT SPECIFICATION

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## DRAWINGS ATTACHED

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 (72) Inventor DAVID JACOB RASBASH



## (54) IMPROVEMENTS IN OR RELATING TO THE CONTROL AND EXTINCTION OF FIRES

(71) I, THE MINISTER OF TECHNOLOGY, London, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the control and extinction of fires and in particular to methods and apparatus for producing foam for this purpose.

Improved methods and apparatus for the production of foam for fire fighting purposes have already been described in U.K. patent specification No. 1,062,771. Foam is produced, according to that invention, by passing the cooled exhaust gases from a turbo-jet engine through a perforate screen on to which liquid together with a foaming agent, which renders the liquid capable of forming foam containing the said gases, is transferred to form a continuously flowing layer, the velocity of the gases when passing through the screen not exceeding approximately 10 feet per second and being if necessary reduced to this value before being passed through the screen.

In order that foam should be efficiently produced it is necessary that the velocity of the gases passing through the perforate screen should not exceed the value above stated. Since the exhaust of a gas-turbine engine normally attains a much higher speed than this it will in virtually all cases embodying the present invention and that described in specification No. 1,062,771 be necessary to reduce the speed of gas flow, for example, by passing the exhaust gas into an expansion chamber or diffuser, or by cooling it with a spray of water, or by both means, before it reaches the perforate screen.

According to the method of the invention, foam for fire fighting purposes is produced by cooling exhaust gases from a gas-turbine engine, causing the cooled exhaust gases to entrain air at ambient temperature and passing the resulting gas mixture through a perforate screen on to which is transferred liquid, preferably water

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together with a foaming agent which renders the liquid capable of forming foam containing the said mixture of gases, the velocity of the gas mixture when passed through the screen not exceeding 10 feet per second.

Preferably the exhaust gases are cooled by transferring liquid into the gases so that the liquid is evaporated, thereby reducing the temperature of said gases.

In an optional method according to the invention the foaming agent is at least one of the substances ammonium lauryl sulphate, sodium lauryl polyethylene glycol ether sulphate, ammonium lauryl polyethylene glycol ether sulphate.

In a further optional method according to the invention the liquid may contain a foam stabiliser which is at least one of the substances hydroxy-methyl cellulose, a fatty alcohol.

Apparatus according to the invention comprises a gas-turbine engine, means for cooling exhaust gases from the engine, means for inducing air into the flow of exhaust gases, a duct for conveying the resulting mixture of exhaust gases and air to a perforate screen and means for supplying liquid and foaming agent to said screen.

Preferably the means for cooling the exhaust gases comprise a duct arranged so that the said exhaust gases pass through the duct, and means for transferring water in finely divided droplets into the duct so that the water is evaporated by the exhaust gases which are thereby reduced in temperature.

The invention will be further described in relation to the drawing accompanying the provisional specification. A gas-turbine engine draws in air as indicated by the arrows 11. The exhaust gases may optionally be further reduced in oxygen content by the combustion of additional fuel in a re-heat section indicated by 13. The exhaust gases will, in general, be too hot and have too high a velocity for immediate application to the generation of foam for fire fighting. This may be remedied by passing the exhaust gases through a further pipe section 14 which serves the purpose of cooler and

advantageously contains means for introducing a controlled amount of finely divided water droplets into the stream of gases. The water is vaporised, and the gases are cooled by supplying the requisite latent heat of vaporisation. The end of the pipe section 14 is arranged within a spaced surrounding duct 15, shown in section, which tapers towards a throat 16. This permits the drawing in of air from the surrounding atmosphere, as indicated by the arrows 17, to mix with the exhaust gases at 18. The duct widens out again, as indicated, in a purely diagrammatic manner, at 19. The increase in cross sectional area brings about a decrease in the velocity of the gases and the decrease can be rendered more marked by the provision of baffles, diagrammatically indicated at 20. The duct 15 is so proportioned, in accordance with the known performance of the gas-turbine engine 11, that the velocity of the gases reaching the extremity 21 of the duct does not exceed 10 ft./sec. The end of the duct is closed by a suitably supported perforate screen 22, which may be a sheet of fabric onto which liquid is sprayed by the sprayer 23. The screen may be stretched across the duct as shown, or may be in the form of an extended cylinder, as illustrated in the drawings of U.K. Patent Specification No. 1,062,711. One sprayer has been shown, but there may be any convenient number that will allow the screen 22 to be substantially uniformly wetted by the liquid. The gases passing through the wetted screen 22 generate a foam consisting of bubbles containing the said gases. For virtually all practical purposes the liquid will be water containing a foaming agent and optionally a foam stabiliser. By way of example, the foaming agent may be ammonium lauryl sulphate, sodium lauryl polyethylene glycol ether sulphate or ammonium lauryl polyethylene glycol ether sulphate; and again by way of example, the stabiliser may be a fatty alcohol or hydroxy-methyl cellulose. Water may be supplied to the sprayer 23 through a pump 24, desirably driven by the gas-turbine engine 11, from the reservoir 25. The foaming agent is supplied to the sprayer from reservoir 26 by pump 27, which also may be driven from the gas-turbine engine. The stabiliser, if used, may be added to the contents of water reservoir 25 in requisite proportion, or supplied from a third reservoir through a third pump or by an in-line inductor to the sprayer 23. In order that the optimum proportions of water to foaming agent may be obtained for given fire conditions the rate of through-put of one or both of pumps 24 and 27 is made variable between suitable limits.

#### WHAT I CLAIM IS:—

1. A method of producing foam for fire-fighting purposes which comprises cooling the exhaust gases from a gas-turbine engine, causing the cooled exhaust gases to entrain air at

ambient temperature and passing the resulting gas mixture through a perforate screen onto which is transferred liquid together with a foaming agent which renders the liquid capable of forming foam containing the said mixture of gases, the velocity of the gas mixture when passed through the screen not exceeding 10 feet per second.

2. A method according to claim 1 in which the exhaust gases are cooled by transferring liquid into the gases so that the liquid is evaporated, thereby reducing the temperature of said gases.

3. A method according to claim 1 in which the foaming agent is ammonium lauryl sulphate.

4. A method according to claim 1 in which the foaming agent is sodium lauryl polyethylene glycol ether sulphate.

5. A method according to claim 1 in which the foaming agent is ammonium lauryl polyethylene glycol ether sulphate.

6. A method according to claim 1 in which the foaming agent is a mixture of any two or more of the substances ammonium lauryl sulphate, sodium lauryl polyethylene glycol ether sulphate, ammonium lauryl polyethylene glycol ether sulphate.

7. A method according to any one of the preceding claims in which the liquid contains, as a foam stabilizer, the substance hydroxy-methyl cellulose.

8. A method according to any one of claims 1 to 6 in which the liquid contains, as a foam stabiliser, a fatty alcohol.

9. A method according to any one of claims 1 to 6 in which the liquid contains, as a foam stabiliser, a mixture of hydroxy-methyl cellulose with a fatty alcohol.

10. A method according to any preceding claim in which the liquid is water.

11. Apparatus for producing foam for fire-fighting purposes which comprises a gas-turbine engine, means for cooling exhaust gases from the engine, means for inducing air into the flow of cooled exhaust gases, a duct for conveying the resulting mixture of exhaust gases and air to a perforate screen and means for supplying liquid and foaming agent to said screen.

12. Apparatus according to claim 11 in which the means for cooling the exhaust gases comprise a duct arranged so that the said exhaust gases pass through the duct, and means for transferring water in finely divided droplets into the duct so that the water is evaporated by the exhaust gases which are thereby reduced in temperature.

13. A method of producing foam for fire-fighting purposes substantially as hereinbefore described.

14. Apparatus for producing foam for fire-fighting purposes substantially as hereinbefore described with reference to the drawings accompanying the provisional specification.

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J. V. ODDFELLOW,  
Chartered Patent Agent,  
Agent for the Applicant.

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